

Application No. 09/985,728
Paper Dated: December 31, 2003
In Reply to USPTO Correspondence of November 17, 2003
Attorney Docket No. 3693-011770 (LC-413)

STATUS OF CLAIMS

Claims 1-61 are presently pending in the application.

Claim 18 has finally been rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Claims 1-3, 9-13, 17, 22-24, 49, and 53-56 have been finally rejected under 35 U.S.C. § 102(e) as allegedly anticipated by U.S. Patent No. 6,265,776 to Gilleo. Moreover, claims 4-8, 14-16, and 18-21 have been finally rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Gilleo and further in view of WIPO Publication No. 00/56799 to Torres-Filho and U.S. Patent No. 6,208,525 to Imasu. Still further, claims 25-48, 50-52, and 57-61 have been finally rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Gilleo, Torres-Filho, and Imasu, and further in view of U.S. Patent No. 6,168,972 to Wang et al.

Each of these rejections is traversed.

STATUS OF AMENDMENTS

In response to a first Office Action dated April 25, 2003, an Amendment dated July 24, 2003 was filed, including amendments to independent claims 1 and 25 clarifying the positioning of the electrical contacts and describing the curable thermosetting underfill composition as being dispensed in flowable form and rendered non-flowable on the circuit chip. Also, language was incorporated into independent claims 49, 54 and 60 to clarify the nature of the thermosetting underfill composition as being deposited in a flowable form and then rendered non-flowable. In a final Office Action dated November 17, 2003, all of claims 1-61 were finally rejected.

SUMMARY OF THE INVENTION

The present invention is directed to a circuit chip provided for attachment to a separate carrier substrate, such as a circuit board. Traditionally, bonding of such circuit chips to a substrate has been achieved by providing electrical contact through a solder joint between electronic circuitry on the circuit chip and on the carrier substrate, and by providing an underfill material between the surfaces of the circuit chip and the carrier substrate, which underfill material may assist in adhering the chip to the substrate. The underfill material has

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traditionally been applied through capillary action after the chip has been bonded to the substrate. In the present invention, the circuit chip is provided as an independent structure including electrical contacts in the form of solder bumps on the surface of the chip, with a fluxing agent disposed on the solder bumps and a distinct and separate curable thermosetting underfill material provided directly on the chip for mating the chip with a separate carrier substrate, and for providing an appropriate underfill material between the chip and the substrate upon mating and solder reflow. The thermosetting underfill composition is applied to the chip die in a flowable form and is partially cured to render it non-flowable, such as through B-staging. Since the underfill material is a thermosetting composition, it can be partially cured or B-staged in this manner to provide the circuit chip with the underfill material partially cured thereon, which underfill material can then be fully cured during solder reflow for attachment of the chip die to the substrate.

ISSUES PRESENTED

The issues include:

I. *Does claim 18 particularly point out and distinctly claim the invention as regards use of the phrase "controllably degradable when exposed to appropriate conditions"?*

II. *Are claims 1-61 anticipated by or rendered obvious over U.S. Patent No. 6,265,776 to Gilleo, whether considered alone or in view of any of WIPO Patent Publication No. 00/56799 to Torres-Filho, U.S. Patent No. 6,208,525 to Imasu and/or U.S. Patent No. 6,168,972 to Wang et al.?*

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ARGUMENTS

Applicants' Response to Section 112, Second Paragraph Rejections

I. *THE PHRASE "CONTROLLABLY DEGRADABLE WHEN EXPOSED TO APPROPRIATE CONDITIONS" PARTICULARLY POINTS OUT AND DISTINCTLY CLAIMS THE INVENTION AND IS THUS DEFINITE WITHIN THE MEANING OF 35 U.S.C. §112, SECOND PARAGRAPH.*

The Office Action alleges that the phrase "controllably degradable when exposed to appropriate conditions" in claim 18 is vague and indefinite.

Definiteness under Section 112, second paragraph, requires that one skilled in the art understand the language of the claims when read in light of the specification, as the claims must be. *Union Pac. Res. Co. v. Chesapeake Energy Corp.*, 236 F.3d 1625, 57 USPQ2d 1293 (Fed. Cir. 2001)(emphasis added). As previously noted, the specification of the present application provides a clear description as to what is meant by "controllably degradable when exposed to appropriate conditions". Paragraphs 0087-0090 of the present application clearly describe the nature of the materials being controllably degradable under appropriate conditions. For example, with reference to being controllably degradable, paragraph 0088 describes the composition as "providing an adhesive for adhering or affixing chip die 62 to a substrate 70, and which is capable of being reworked under appropriate conditions, such as by softening or degradation, with a loss of adherence so as to release chip die 62 from substrate 70." As an example of a useful material, paragraph 0088 further describes "a compound having a cleavable linkage within the chemical structure thereof", including those which are "capable of softening under exposure to elevated temperature conditions, such as those in excess of the temperatures used to cure the composition, and desirably in excess of those used to reflow the solder". Moreover, specific examples of useful materials are set forth throughout the specification. Applicants submit that one skilled in the art, reading the claim language in light of the specification which includes a specific

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description of this property and provides specific examples of useful materials, would understand the claim.

The Action states that "the Examiner cannot read language from the specification into the claims." Applicants have not suggested that the Examiner read language from the specification into the claims, as alleged. Instead, Applicants request that the claims be interpreted in light of the specification, as the law clearly requires. It is well settled law that definiteness under §112, second paragraph, requires an examination of the claims as a whole in light of the specification and the prior art. *See, e.g., S3 Inc. v. nVidia Corp.*, 259 F. 3d 1364, 59 USPQ2d 1745 (Fed. Cir. 2001).

Applicants submit that a complete reading of the specification clearly sets forth appropriate conditions and sets forth what is meant by controllably degradable. Accordingly, when read in light of the specification, the phrase "controllably degradable when exposed to appropriate conditions" is in fact clear, and refers to materials which are reworkable according to the teachings of the specification. As such, the claims are definite within the meaning of 35 U.S.C. § 112, second paragraph. Reconsideration and withdrawal of the rejection are therefore requested.

Applicants' Response to Section 102 and Section 103 Rejections

II. *U.S. PATENT NO. 6,265,776 TO GILLES FAILS TO ANTICIPATE OR RENDER OBVIOUS ANY OF CLAIMS 1-61, WHETHER CONSIDERED ALONE OR IN VIEW OF ANY OF WIPO PATENT PUBLICATION NO. 00/56799 TO TORRES-FILHO, U.S. PATENT NO. 6,208,525 TO IMASU AND/OR U.S. PATENT NO. 6,168,972 TO WANG ET AL.*

As noted above and as the Examiner is well aware, the present invention is directed to a circuit chip provided with electrical contacts, which further includes a fluxing agent and a distinct and separate curable thermosetting underfill material provided on the chip for mating the chip with a carrier substrate, and for providing an appropriate underfill material between the chip and the substrate upon mating and solder reflow. The thermosetting underfill composition is applied to the chip die in flowable form and partially

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cured to render it non-flowable, such as through B-staging, due to the nature of the underfill material being a thermosetting composition. The underfill material can thereafter be fully cured upon solder reflow during the attachment of the chip die to the substrate. Thus, the invention as presently defined requires the underfill to be thermosetting.

The Office Action alleges that the claims are clearly anticipated by Gilleo.

To anticipate a claim under 35 U.S.C. §102, a single reference must disclose each and every element of the claimed invention. *Lewmar Marine v. Barient Inc.*, 3 USPQ2d 1766 (Fed. Cir. 1987). Absence from the reference of any claimed element negates anticipation. *Kloster Speedsteel AB v. Crucible Inc.*, 793 F.2d 1565 (Fed. Cir. 1986).

Gilleo discloses a flip chip having solder bumps thereon, with an integrated flux coating and a thermoplastic underfill material. While Gilleo teaches a flip chip similar to that claimed in the present invention, Gilleo requires that the underfill material be a thermoplastic material, not a thermosetting material.

As noted, anticipation under section 102 requires that a reference disclose each and every element. The present invention requires that the underfill material be a thermosetting material, not a thermoplastic one. Simply speaking, Gilleo fails to teach a thermoset as the underfill material.

Instead, Gilleo is directed entirely to the use of thermoplastic materials as an underfill for circuit chips. In fact, Gilleo specifically criticizes using thermosetting materials as an underfill, noting the problems that are inherent with thermosetting materials. While Gilleo acknowledges that thermosetting materials may be included with a thermoplastic material as an underfill, Gilleo fails to disclose thermosets as a useful underfill material apart from thermoplastic materials. This deficient teaching is consistent with the overall tone of Gilleo, which is clearly critical of thermosetting materials as underfills. Accordingly, Gilleo cannot anticipate the present invention, which clearly requires that the underfill material be a thermoset.

Further, when interpreting the patentability of a claim, the law requires that a reference be considered for all of its teachings, including disclosure that diverges and teaches away from the invention at hand as well as disclosures that point toward and teach the invention. *In re Dow Chem. Co.*, 837 F.2d 469, 5 USPQ2d 1529 (Fed. Cir. 1988)(emphasis added). The Federal Circuit has repeatedly recognized that proceeding contrary to the

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accepted wisdom in the art represents strong evidence of unobviousness and patentability. *In re Hedges*, 783 F.2d 1038, 1041, 228 USPQ 685, 687 (Fed. Cir. 1986); *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1552, 220 USPQ 303, 312 (Fed. Cir. 1983). The Examiner, however, has failed to recognize that Gilleo teaches away from the use of thermosets as in the present invention.

Gilleo not only fails to recognize the advantages achieved through the use of a thermosetting resin as the underfill material, but even goes so far as to teach away from the use of a thermosetting resin as the sole underfill material. Quite simply, Gilleo is not directed to curable thermosetting underfill compositions. Instead, the teachings of Gilleo as a whole are directed to the use of thermoplastic materials instead of thermoset underfill materials.

In particular, the Office Action contends at page 2 that "just because the focus [in Gilleo] is on a thermoplastic material does not eliminate the fact that a thermoset can function in the same capacity as the thermoplastic, since the underfill material in the particular embodiment can be either material." However, merely because something could work in a particular capacity does not provide a basis for rejecting the claim absent some motivation in the reference. *In re Mills*, 916 F.2d 680, 682, 16 USPQ2d 1430, 1432 (Fed. Cir. 1990). Merely because the present inventors have discovered how to make a thermoset material work does not provide a basis for the Examiner to contend that Gilleo teaches that a thermoset can function in the same capacity as a thermoplastic, particularly when this is contrary to the entire teachings of Gilleo.

For example, the entire specification of Gilleo revolves around solving problems that are allegedly inherent with thermoset underfill materials. Gilleo states at column 6, lines 15-21 that "thermoset underfill materials do not allow the assembly to be reworked since thermosets cannot be melted once they have cross-linked. The present invention eliminates the problems associated with thermoset underfills by incorporating a thermoplastic resin as the main component of the underfill." Clearly, Gilleo is directed to replacing thermoset underfill materials with thermoplastic underfill materials. One skilled in the art, reading Gilleo in its entirety as is required, would in no way be motivated to use a thermosetting resin as the underfill material in an assembly in view of the assertive statements in Gilleo which discourage the use of such thermosets and attempt to solve the alleged problems of using thermosets.

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The claims of the present invention, on the other hand, require a curable thermosetting underfill composition as the underfill material. In the present invention, thermosetting underfill materials are desired due to the ability to be B-staged or partially cured, thereby providing the circuit chip as a separate structure including the fluxing agent and the partially cured thermosetting underfill composition in a solid form thereon, which can then be mated with the substrate and heated to reflow the electrical contacts and fully cure the thermosetting underfill material. Such thermosetting underfill materials are quite different from the thermoplastic underfill materials as taught by the Gilleo reference.

The Office Action further states that "the Examiner has reviewed Gilleo as a whole when considering replacing the thermoplastic material with a thermoset having a very low crosslink density." This statement is contradictory to the law. If a reference is considered as a whole, one particular element of that reference cannot be given substantial weight if it goes against the overall teachings. The sole, casual statement that the underfill material is preferably a thermoplastic or a thermoset having a specific crosslink density is counter to the overall explicit teachings in the patent. Applicants submit that to consider Gilleo "as a whole when considering replacing the thermoplastic material with a thermoset" goes against the intent of the patent laws, since Gilleo only briefly mentions the use of thermosets and when considered for all of its teachings directs away from their use. If the Examiner actually considered Gilleo as a whole, he would not focus on one comment in Gilleo which mentions thermosets, but instead would look to its overall intent which is to replace thermosets with thermoplastics due to the allegedly inherent difficulties with thermosets. This statement by the Examiner in the Office Action therefore demonstrates that the Examiner has failed to consider Gilleo for its entire teachings.

When Gilleo is considered as a whole, the reference clearly teaches away from the present invention by specifically noting that thermoset underfills are not particularly useful. In fact Gilleo as a whole describes how to eliminate the problems which are typically associated with thermoset underfill materials. With such clear and unequivocal teaching away, Gilleo does not anticipate the present invention, which clearly requires a thermosetting underfill material in the claims, and instead teaches away from the use of such thermosetting materials.

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Moreover, the additional documents cited in combination with Gilleo fail to provide any teachings which would cure the deficiencies of Gilleo. In particular, the Torres-Filho patent publication relates to thermosetting resin compositions which are reworkable when subjected to appropriate conditions. Such reworkable thermosetting compositions are very different than the thermoplastic compositions taught by Gilleo. Accordingly, the Torres-Filho publication is not properly combinable with the Gilleo reference. The Office Action argues that this is not persuasive "since Torres-Filho is not relied upon to show a pre-applied semiconductor circuit chip", but instead that "Torres-Filho is only relied upon to show that a thermosetting underfill composition comprises a curable component made of epoxy resin...". To rely on the prior art references as such, however, is improper, since Gilleo teaches away from the use of thermosets. One skilled in the art, reading Gilleo for its entire teachings as is required, would not look to use thermosetting underfills, and would therefore have no motivation to consider any thermosetting materials disclosed in Torres-Filho, since Gilleo teaches that thermosets are problematic.

Imasu has merely been cited for its alleged teachings with respect to semiconductor chips made of silicon. As is apparent, however, Imasu fails in any way to teach or disclose a circuit chip in accordance with the present invention which involves distinct and separate fluxing agents and thermosetting underfill materials disposed on a chip. Accordingly, Imasu clearly fails to add any teachings to the deficiencies of Gilleo.

Wang has been cited with specific reference to a further embodiment of the present invention set forth in claim 25, where the underfill material comprises a first thermosetting underfill composition which is dispensed in flowable form over the chip die, and a second thermosetting underfill composition which is dispensed in flowable form over the first thermosetting underfill composition. Wang, however, fails to provide any teachings directed to this specific arrangement. As previously pointed out to the Examiner, Wang does not involve dispensing a second thermosetting underfill composition on a first thermosetting underfill composition, let alone rendering such compositions non-flowable on the chip surface. Instead, Wang clearly discloses providing separate underfill compositions on separate members, namely on chip 200 and on substrate 300, followed by alignment and reflow to attach the chip and the substrate together through the underfill materials. The Office Action contends that "the second thermosetting underfill composition 310 is rendered